

A small number of basidia were observed which seemed to bear two pairs of spores. When carefully focussed, some of these resolved themselves into two superimposed basidia, others seemed to be instances where a loose spore had become attached to the side of the basidium, but in a very few instances there seemed to be four spores, fused or unfused, actually present. If this interpretation is correct, it is probably to be regarded as an aberration such as is characteristic of the Tremellales.

In addition to basidia, the hymenium includes a small number of clavate, hyphal tips with highly vacuolate and somewhat refringent contents, attaining 80μ in length and 5μ in diameter near the tips. They are borne on the same hyphae as the basidia. In some cases they represent the ends of the large axial hyphae bearing the basidiophores, while in others they originate amongst a cluster of basidia. They are evidently to be regarded as cystidia.

The fusion of the spores must result in the immediate restoration of the dicaryon phase. This phenomenon seems to be distinct from anything known heretofore in the Basidiomycetes in that fusion results in a distinct, diploid spore serving as a disseminule. It must, however, be regarded as homologous with the familiar fusion of sporidia either while still attached to the basidium ("promycelium") of many of the smuts or immediately after separation, first announced and illustrated by the Tulasnes³ and later by DeBary, Brefeld and many others. It is perhaps even closer to the fusion between the cells of the basidium as demonstrated by Rawitscher for *Cintractia Montagnei*.⁴ In the smuts, however, the smut spore, or probasidium, is the primary disseminule, and the fusion product either grows directly into a mycelium or proceeds to develop secondary basidiospores which are forcibly discharged and then function as disseminules.⁵ The fusion of basidiospores in *Syzygospora* is significant as illustrative of a tendency in the group which may have been modified and developed in the smuts and adapted to their highly specialized ecological requirements.

ZOOLOGY.—*North American monogenetic trematodes. I. The superfamily Gyrodactyloidea.*¹ EMMETT W. PRICE, U. S. Bureau of Animal Industry.

The monogenetic or ectoparasitic trematodes comprise a wide variety of more or less bizarre flatworms occurring on fishes and other aquatic animals. These forms are most commonly encountered on the skin and gills of marine and fresh-water fishes. Several species occur in the mouth and upper respiratory tract of turtles and in the urinary bladder of turtles and frogs. A few have been found on crustaceans and cephalopods, and one species has been reported from the eyes of

³ Ann. Sci. Nat. Bot. IV 2: 157-159. 1854.

⁴ Ber. deut. bot. Gesell. 32: 281-287. 1914.

⁵ BULLER. *Res. on Fungi*, 5: 207-278. 1933.

¹ Received January 29, 1937.

an aquatic mammal. The literature dealing with this group of trematodes is fairly extensive, although only a few papers have appeared which may be regarded as monographic in scope. The most important are those by Braun (1889-1893), Saint Remy (1891a and b, 1892, 1898), Goto (1894), Johnston and Tiesg (1922) and Fuhrmann (1928).

The first monogenetic trematode from a North American host was described as an "insect" by La Martinière (1787), and was found on the skin of a fish collected somewhere between Monterey Bay, California, and Nootka Island. The true nature of this "insect" was determined by Bosc (1811). Since that time more than 40 papers have appeared which deal either wholly or in part with North American representatives of the order Monogenea. The most extensive studies of these forms were made by the late Dr. G. A. MacCallum (14 papers appearing from 1913 to 1931), and by Stunkard (1917), Mueller (1934, 1936) and Mizelle (1936).

This paper, which is the first of several to appear under the general heading of *North American monogenetic trematodes*, is limited to the superfamily Gyrodactyloidea. Subsequent papers will deal with other major groups and will appear in sequence. In all of these papers will be given diagnoses and keys for all groups as far as genera, and when taken together these papers will represent a revision of the entire order Monogenea. Under each genus is given a list of all species known to belong to that group. However, no attempt has been made in each instance to pass judgment on the validity of the exotic representatives of these genera. The species of which detailed descriptions are given are those from this continent that have been inadequately characterized and those in which important characters have been overlooked or misinterpreted. A few new species have been included, but no particular effort has been made to obtain new forms since the mere describing of new species is regarded of minor importance as compared with redescriptions of imperfectly known old species.

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Order MONOGENEA Carus, 1863²

Synonyms.—Cryptocoela Johnston, 1865; Ectoparasitica Lang, 1888; Eterocotylea Monticelli, 1892; Heterocotylea Braun, 1893; Monogenetica Haswell, 1893; Heterocotylida Lahille, 1918.

Diagnosis.—Small to medium sized ectoparasitic flukes, with elongated to leaf-like bodies. Anterior end of body with or without haptors; posterior end always with a haptor, the haptor usually provided with hooks or suckers, or with both hooks and suckers. Mouth ventral or subterminal, at or near anterior end; pharynx always present, well developed; intestine single or double. Eyes present or absent. Excretory system double, opening dorsally through 2 symmetrically placed pores at or near level of genital aperture. Always hermaphroditic; genital apertures usually opening into a common sinus. Genito-intestinal canal present or absent. Uterus usually short; eggs few, frequently provided with polar prolongations. Development direct, i.e., without alternation of generations and without alternation of hosts; metamorphosis incomplete. Usually parasites of cold-blooded vertebrates or of crustaceans parasitic on vertebrates, rarely on cephalopods and mammals.

Odhner (1912) has proposed a division of the Monogenea into two suborders, Monopisthocotylea and Polyopisthocotylea, on the basis of the presence or absence of a genito-intestinal canal, and most authors have accepted Odhner's proposal. Fuhrmann (1928), however, recognizes three suborders, namely, Monopisthodiscinea, Monopisthocotylea and Polyopisthocotylea, the first two of these groups being the result of splitting Odhner's Monopisthocotylea into two suborders, while the third is equivalent to Polyopisthocotylea Odhner. The writer fails to see sufficient fundamental difference to warrant subdividing the Monopisthocotylea into two suborders, preferring to retain the groups as proposed by Odhner, and has proposed two superfamilies to replace the first two of Fuhrmann's suborders.

KEY TO THE SUBORDERS OF MONOGENEA

- Genito-intestinal canal present Polyopisthocotylea Odhner
- Genito-intestinal canal absent Monopisthocotylea Odhner

Suborder MONOPISTHOCOTYLEA Odhner, 1912

Synonyms.—Monocotylea Blainville, 1828; Tricotylea Diesing, 1850; Tristomeae Taschenberg, 1879; Oligocotylea Monticelli, 1903; Monopisthodiscinea Fuhrmann, 1928; Monopisthocotylea Fuhrmann, 1928.

Diagnosis.—Anterior haptors present or absent, when present consisting of a weakly developed oral sucker, or of 2 lateral suckers not opening into oral cavity, or of 2 elongate depressions near anterior end of body with numerous small unicellular glands opening into them; when haptors absent, adhesive function supplied by cephalic glands opening singly at anterior

² Most authors credit the name of this order to Van Beneden (1858), but this seems to be an error. Van Beneden proposed a division of the trematodes into two major groups, "monogénèses" and "digénèses," the names being in the vernacular form. The first to use the name Monogenea for the order appears to have been Carus (1863).

margin of body or through one or more pairs of head organs. Posterior haptor disc-like, usually well developed, its ventral surface with or without septa, never bearing distinct suckers or clamp-like attaching organs, usually armed with 1 to 3 pairs of large hooks and a number (2 to 16) of marginal hooklets; large hooks frequently supported by transverse cuticular bars. Eyes present or absent. Genito-intestinal canal absent, except possibly in Protogyrodactylidae. Vagina present or absent.

KEY TO SUPERFAMILIES OF MONOPISTHOCOTYLEA

- Posterior haptor armed; large hooks with supporting bars..... Gyrodactyloidea. Johnston and Tiegs
-Gyrodactyloidea. Johnston and Tiegs
- Posterior haptor armed or unarmed; when armed, large hooks without supporting bars..... Capsaloidea Price

Superfamily GYRODACTYLOIDEA Johnston and Tiegs, 1922

Diagnosis.—Anterior haptors absent; cephalic glands present, usually in 2 groups, 1 group on each side of pharynx, with ducts opening to exterior through 1 or more pairs of head organs. Posterior haptor disc-like, sometimes wedge-shaped, bearing 1 to 2 pairs of large hooks, the hooks almost always supported by 1 to 2, rarely 3, cuticular bars. Intestine sac-like or consisting of 2 branches with or without diverticula, the later, when present, short. Genital aperture median or submedian. Cirrus simple, cuticular, frequently with complicated cuticular accessory structure. Vagina present or absent. Vitello-intestinal canal rarely present. Oviparous or viviparous.

Type family.—Gyrodactylidae Cobbold, 1877.

KEY TO FAMILIES OF GYRODACTYLOIDEA

- 1. Viviparous.....Gyrodactylidae Cobbold
- Oviparous.....2
- 2. Vitello-intestinal duct present. Protogyrodactylidae Johnston and Tiegs
- Vitello-intestinal duct absent.....3
- 3. Anterior end of body expanded to form head lappets.....
-Calceostomatidae Parona and Perugia
- Anterior end of body not expanded to form head lappets.....
-Dactylogyridae Bychowsky

Family GYRODACTYLIDAE Cobbold, 1877

Diagnosis.—Small, elongated Monogenea, with 2 head organs. Haptor well developed, usually bearing 1 pair of large hooks (absent in Isancistrinae) and 15 or 16 marginal hooklets. Intestine branched, the 2 limbs not uniting posteriorly. Eyes absent. Male copulatory organ armed with a row of minute spines and usually with a triangular cuticular plaque. Ovary V-shaped, or lobed, posttesticular. Vitellaria absent or united with ovary. Vagina absent. Viviparous. Parasites of fishes, amphibians and cephalopods.

Type genus.—*Gyrodactylus* Nordmann, 1832.

Many authors, including Johnston and Tiegs (1922), Fuhrmann (1928), Froissant (1930) and Bychowsky (1933), credit the name of this family to Van Beneden and Hesse (1863), but these authors used the name "Gyrodactylides" and not "Gyrodactylidae"; the first to use the correct form of the family name appears to have been Cobbold (1877).

KEY TO SUBFAMILIES OF GYRODACTYLIDAE

- Haptor with 2 large hooks and 16 marginal hooklets. Gyrodactylinae Monticelli
- Haptor without large hooks but with 15 marginal hooklets. Isancistrinae Fuhrmann

Subfamily GYRODACTYLINAE Monticelli, 1892

Diagnosis.—Anterior end bilobed, each lobe with a head organ. Haptor circular, with 1 pair of large hooks and 16 marginal hooklets. Parasites of fishes and amphibians.

Type genus.—*Gyrodactylus* Nordmann, 1832.

Genus GYRODACTYLUS Nordmann, 1832

Diagnosis.—Characters of the subfamily.

Type species.—*Gyrodactylus elegans* Nordmann, 1832.

The genus *Gyrodactylus* contains the following species: *G. elegans* Nordmann, 1832; *G. groenlandicus* Levinsen, 1881; *G. gracilis* Kathariner, 1894; *G. medius* Kathariner, 1894; *G. rarus* Wegener, 1910; *G. fairporti* Van Cleave, 1921; *G. japonicus* Kikuchi, 1929; *G. cobitus* Bychowsky, 1933; *G. latus* Bychowsky, 1933; *G. parvicopula* Bychowsky, 1933; *G. cylindriciformis* Mueller and Van Cleave, 1932; *G. elegans* vars. A. and B. Mueller, 1936; and *G. gurleyi*, n. sp. Of these species, *G. fairporti*, *G. elegans* vars. A and B, *G. spathulatus* and *G. gurleyi* are from North American fish hosts. *G. elegans* Nordmann has been reported from fishes in Maine by Atkins (1901) and in Washington by Guberlet, Hansen and Kavanagh (1927) but whether these reports indicate the occurrence of the European species by that name is open to question. The report by Cooper (1915) of the occurrence of *G. medius* Kathariner from North America is likewise questionable, as the description and figure given by Cooper indicate that he was dealing with some species other than *G. medius*.

In addition to the species listed above, reports of species of *Gyrodactylus* from North American fishes have been given by a number of writers, including Davis (1929) and Hess (1930) but no evidence is given in these reports that would enable one to determine the species involved. Recently Stunkard and Dunihue (1933) reported the occurrence of a species of *Gyrodactylus* on tadpoles of *Rana catesbeiana*, constituting the first report of a species of this genus parasitizing an amphibian.

***Gyrodactylus gurleyi*, n. sp.**

Fig. 1

Description.—Body elongate, 435 to 510 μ long by 60 to 76 μ wide, width about uniform throughout length of body proper; anterior end bifid and provided with 1 pair of head organs; cephalic glands present on each side of pharynx. Haptor circular, about 76 μ wide, armed with 1 pair of large hooks supported by a delicate dorsal bar and a similar ventral bar, and with 16 marginal hooklets; ventral bar at level of proximal ends of large hooks. Large hooks 45 to 49 μ long; marginal hooklets about 23 μ long. Oral aperture ventral, about 75 μ from anterior end; esophagus very short; intestinal

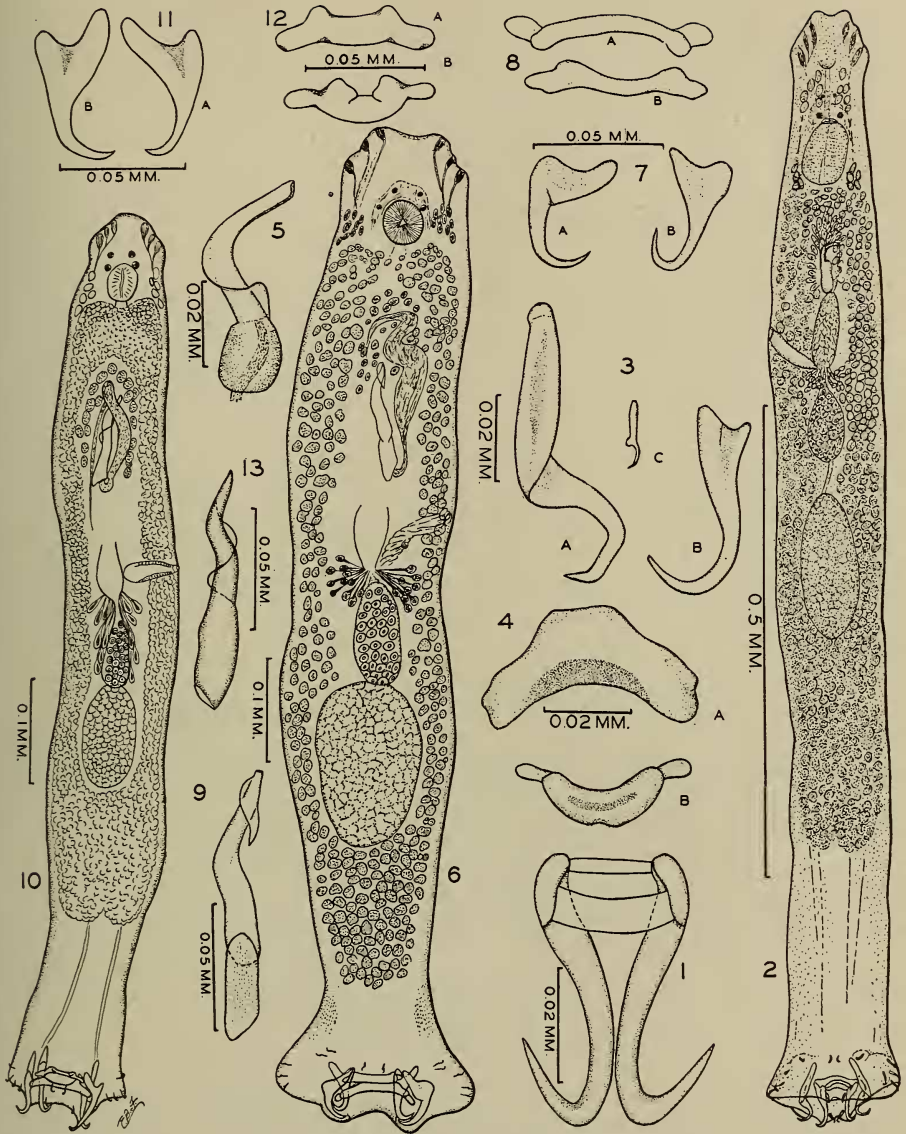


Fig. 1.—*Gyrodactylus gurleyi*. Large haptor hooks, dorsal view. Figs. 2-5.—*Ancyrocephalus teuthis*. 2, Complete worm, ventral view; 3, haptor hooks (A—hook of dorsal pair, B—hook of ventral pair, C—marginal hooklet); 4, haptor bars (A—dorsal bar, B—ventral bar); 5, cirrus. Figs. 6-9.—*Ancyrocephalus lactophrys*. 6, Complete worm, ventral view; 7, large haptor hooks (A—hook of ventral pair, B—hook of dorsal pair); 8, haptor bars (A—ventral bar, B—dorsal bar; drawn to same scale as Fig. 7); 9, cirrus. Figs. 10-13.—*Ancyrocephalus similis*. 10, Complete worm, ventral view; 11, haptor hooks (A—hook of ventral pair, B—hook of dorsal pair); 12, haptor bars (A—ventral bar, B—dorsal bar); 13, cirrus.

branches simple. Genital apertures not observed. Testis oval, 20 to 38 μ long by 20 to 25 μ wide, median, about 155 μ from posterior end of body proper. Ovary an indistinct mass occupying greater part of body width and extending from level of testis to near posterior end of body proper. Ovum about 23 to 27 μ in diameter, lying immediately anterior to testis. Uterus in equatorial third of body, containing 1 to 2 developing embryos.

Host.—Gold fish ("Japanese fan-tail").

Location.—Fins.

Distribution.—United States (Texas).

Specimens.—U. S. N. M. Helm. Coll. No. 39584.

The above description is based on a slide mount of a portion of the fin of a gold fish to which were attached several specimens of gyrodactylids. The slide was labeled "*Gyrodactylus elegans*—Japanese fan-tail—Dr. Gurley, Sept. 1891." The locality was not given, but Dr. A. Hassall has informed the writer that these specimens had been collected in Texas. The specimens were not in good condition and a complete description is, therefore, impossible. The general appearance of the worms corresponds closely to that of *G. medius* as described by Kathariner (1895) and by Wegener (1910), but the ventral supporting bar of the large haptor hooks is placed at the level of the proximal ends of the hooks while in *G. medius* this bar is placed much farther back. It is on the basis of the position of this bar that the species is considered new.

Subfamily ISANCISTRINAE Fuhrmann, 1928

Diagnosis.—Anterior end truncate, with 1 pair of head organs. Haptor without large hooks, with 15 marginal hooklets. Parasites of cephalopods.

Type genus.—*Isancistrum* de Beauchamp, 1912.

Genus ISANCISTRUM de Beauchamp, 1912

Diagnosis.—Characters of subfamily.

Type species.—*Isancistrum loliginis* de Beauchamp, 1912.

The type and only species. *I. loliginis*, was described by de Beauchamp (1912) from specimens collected from *Loligo media* Linnaeus; this parasite is not known to occur on North American hosts.

Family PROTOGYRODACTYLIDAE Johnston and Tiegs, 1922

Diagnosis.—Minute forms, about as broad as long; cephalic glands present, opening to exterior through well developed head organs. Haptor well developed, with 2 pairs of large hooks and with a number of relatively large marginal hooklets. Intestine branched, the two limbs may or may not unite posteriorly. Eyes present. Testis and ovary unbranched. Cirrus simple, cuticular, tube-like. Vitelline glands lateral, arranged in 2 groups, one preovarial and the other postovarial; transverse vitelline ducts connected by median longitudinal duct; posterior transverse vitelline duct with definite connection with intestinal limbs. Vagina absent. Parasites of fresh-water fishes.

Type genus.—*Protygyrodactylus* Johnston and Tiegs, 1922.

KEY TO GENERA OF PROTOGYRODACTYLIDAE

Posterior vitelline system double *Trivitellina* Johnston and Tiegs
 Posterior vitelline system single *Protygyrodactylus* Johnston and Tiegs

Genus PROTOGYRODACTYLUS Johnston and Tiegs, 1922

Diagnosis.—Haptor broad, not sharply set off from body proper, strongly “padded,” provided with 2 pairs of large hooks and 12 marginal hooklets, the latter relatively large. Intestinal branches not united posteriorly. Vitellaria consisting of a preovarial and a postovarial system; posterior transverse vitelline duct communicating with intestine.

Type species.—*Protygyrodactylus quadratus* Johnston and Tiegs, 1922.

The type and only species of this genus occurs on the gills of *Therapon carbo* Ogilby and McCulloch and *T. hilli* Castelnau in Australia.

Genus TRIVITELLINA Johnston and Tiegs, 1922

Diagnosis.—Haptor sharply set off from body, not strongly “padded,” provided with 2 pairs of large hooks and 12 marginal hooklets as in *Protygyrodactylus*. Intestinal branches united posteriorly. Vitellaria consisting of 1 preovarial system and 2 postovarial systems, one of the latter connected with the intestine.

Type species.—*Trivitellina subrotunda* Johnston and Tiegs, 1922.

The type and only species of this genus is known only from Australia where it occurs on the gills of *Therapon fuliginosus* Macleay.

Family DACTYLOGYRIDAE Bychowsky, 1933

Synonyms.—Gyrodactylidae Cobbold, 1877, in part; Amphibdellidae Carus, 1885.

Diagnosis.—Anterior end with 2 or more pairs of head organs; cephalic glands lateral, or distributed throughout median, preoral area (Bothitrematinae). Haptor moderately to well developed, with or without accessory structures or squamodiscs, and with 1 or 2 pairs of large hooks and usually 14 marginal hooklets. Ovary globular, sometimes curved, pretesticular. Vitellaria well developed. Vagina present or absent. Oviparous. Parasites of fishes.

Type genus.—*Dactylogyru*s Diesing, 1850.

KEY TO SUBFAMILIES OF DACTYLOGYRIDAE

- 1. Haptor with 1 pair of large hooks 2
 Haptor with 2 pairs of large hooks 3
- 2. Haptor with a circle of heavily cuticularized, tubular structures
 Bothitrematinae Price
- Haptor without circle of tubular structures. Dactylogyrinae Bychowsky
- 3. Haptor with a pair (dorsal and ventral) of accessory structures or squamodiscs Diplectaninae Monticelli
 Haptor without accessory structures or squamodiscs
 Tetraonchinae Monticelli

Subfamily DACTYLOGYRINAE Bychowsky, 1933

Synonyms.—Gyrodactylinae Monticelli, 1892, in part.

Diagnosis.—Haptor moderately developed, without squamodiscs, with 1

pair of large hooks supported by 1 or 2 heavily cuticularized clamp-like bars, and with 14 marginal hooklets. Intestine double, branches usually, if not always, united posteriorly. Eyes present. Testis and ovary rounded, the latter always pretesticular. Vagina present, with or without cuticular supporting structures.

Type genus.—*Dactylogyrus* Diesing, 1850.

Genus DACTYLOGYRUS Diesing, 1850

Diagnosis.—Characters of subfamily.

Type species.—*Dactylogyrus auriculatus* (Nordmann, 1832) Diesing, 1850.

The genus *Dactylogyrus* contains the following species: *D. aequans* Wagener, 1857; *D. affinis* Bychowsky, 1933; *D. alatus* Linstow, 1878; *D. amphibothrium* Wagener, 1857; *D. anchoratus* (Dujardin, 1845); *D. auriculatus* (Nordmann, 1832); *D. bini* Kikuchi, 1929; *D. chranilowi* Bychowsky, 1933; *D. cornu* Linstow, 1878; *D. crucifer* Wagener, 1857; *D. cryptomeres* Bychowsky, 1934; *D. kulwieci* (Bychowsky, 1931); *D. cyprini* Buschkiel, 1930; *D. difformis* Wagener, 1857; *D. dujardinianus* (Diesing, 1850); *D. extensus* Mueller and Van Cleave, 1932; *D. falcatus* (Wedl, 1857); *D. fallax* (Wagener, 1857); *D. formosus* Kulwiec, 1927; *D. fraternus* Wegener, 1910; *D. frisii* Bychowsky, 1933; *D. gracilis* Wedl, 1861; *D. haplogonus* Bychowsky, 1933; *D. intermedius* Wegener, 1910; *D. inversus* Goto and Kikuchi, 1917; *D. macracanthus* Wegener, 1910; *D. malleus* Linstow, 1877; *D. megastoma* Wagener, 1857; *D. minor*, Wagener, 1857; *D. minutus* Kulwiec, 1927; *D. mollis* (Wedl, 1857); *D. nybelini* Markevich, 1933; *D. parvus*, Wegener, 1910; *D. propinquus* Bychowsky, 1931; *D. puntii* Buschkiel, 1930; *D. siluri* Wagener, 1857; *D. similis* Wegener, 1910; *D. simplicimalleata* Bychowsky, 1934; *D. sphyrna* Linstow, 1878; *D. tenuis* Wedl, 1857; *D. tuba* Linstow, 1878; *D. uncinatus* Wagener, 1857; *D. vastator* Nybelin 1924 (syn. *D. crassus* Kulwiec, 1927); *D. wegneri* Kulwiec, 1927; *D. wunderi* Bychowsky, 1931; and *D. zandti* Bychowsky, 1933. Only two of these species, *D. extensus* and *D. anchoratus*, are known to occur in North America, the former occurring on the gills of *Cyprinus carpio* and the latter on *Carassius auratus*.

Subfamily TETRAONCHINAE Monticelli, 1903

Diagnosis.—Body devoid of scales or spines. Haptor without squamodiscs, with 2 pairs of large hooks and (?) 2 to 16 marginal hooklets. Intestine single or double. Eyes present or absent. Testis usually without lobes. Ovary without lobes. Vagina present or absent.

Type genus.—*Tetraonchus* Diesing, 1858.

KEY TO GENERA OF TETRAONCHINAE³

1. One pair of head organs. *Diplectanotrema* Johnston and Tiegs
- More than 1 pair of head organs. 2

³ The recent genera by Mueller (1936, 1937) may not all be valid; they have been included in this key pending further study. *Dactylodiscus* Olsson is omitted from the key as it is too imperfectly known; it may belong to this subfamily and is appended as a genus inquirenda.

2. Intestine single.....*Tetraonchus* Diesing
 Intestine double.....3
3. Intestine uniting posteriorly.....4
 Intestine not uniting posteriorly.....15
4. Eyes absent.....*Tetrancistrum* Goto and Kikuchi
 Eyes present.....5
5. Vitellaria not extending into posterior third of body.....6
 Vitellaria extending into posterior third of body.....7
6. Vagina present.....*Daitreosoma* Johnston and Tiegs
 Vagina absent.....*Empleurosoma* Johnston and Tiegs
7. Dorsal and ventral haptoral hooks dissimilar....*Aristocleidus* Mueller
 Dorsal and ventral haptoral hooks similar.....8
8. Haptor disc-like; haptoral bars articulate.....*Actinocleidus* Mueller
 Haptor wedge-shaped; haptoral bars non-articulate.....9
9. Large haptoral hooks unequal, ventrals about one-half as large as dorsals
*Haplocleidus* Mueller
 Large haptoral hooks equal or nearly so.....10
10. Large hooks each with flattened blade arising near angle.....
*Pterocleidus* Mueller
 Large hooks without blades.....11
11. Marginal hooklets relatively large, 6 pairs arranged around anterior
 edge of haptor, their points projecting forward.....
*Onchocleidus* Mueller
 Marginal hooklets relatively small, mostly projecting backward...12
12. Cirrus long and slender, thrown into wide spiral; without movable ac-
 cessory piece.....*Leptocleidus* Mueller
 Cirrus usually short, with movable accessory piece.....13
13. Vagina absent.....*Urocleidus* Mueller
 Vagina present.....14
14. Vagina dextral.....*Tetracleidus* Mueller
 Vagina sinistral.....*Cleidodiscus* Mueller
15. Eyes present.....16
 Eyes absent.....18
16. Vagina absent.....*Anchylodiscus* Johnston and Tiegs
 Vagina present.....17
17. Vagina aperture median; haptor with 3 bars.....*Murraytrema*, n. g.
 Vaginal aperture lateral; haptor with 2 bars....*Ancyrocephalus* Creplin
18. Haptor without bars.....*Amphibdella* Chatin
 Haptor with 1 or 2 bars.....19
19. Haptor with 1 bar.....*Amphibdelloides*, n. g.
 Haptor with 2 bars.....*Haliotrema* Johnston and Tiegs

Genus TETRAONCHUS Diesing, 1858

Synonym.—*Monocoelium* Wegener, 1910.

Diagnosis.—Cephalic glands opening to exterior through several pairs of head organs. Haptor more or less distinctly set off from body proper, with 2 pairs of large hooks supported by a single large transverse cuticular bar; 16 marginal hooklets. Intestine single, without diverticula. Eyes present. Testes and ovary in equatorial zone. Vagina absent.

Type species.—*Tetraonchus monenteron* (Wagener, 1857) Diesing, 1858.

The genus *Tetraonchus* contains two species, *T. monenteron* (Wagener, 1857), reported by Van Cleave and Mueller (1934) from *Esox lucius* from

Oneida Lake, New York, and *T. alaskensis* Price, reported by the present writer (1937) from the gills of *Salmo mykiss* Walbaum, *Salvelinus malma spectabilis* (Giard) and *Oncorhynchus kisutch* Walbaum from Alaska.

Genus ANCYROCEPHALUS Creplin, 1839

Synonyms.—*Diplectanum* Auct.; *Tetraonchus* Diesing, 1858, in part.

Diagnosis.—Head organs usually 3 pairs. Haptor indistinctly set off from body proper. Large hooks supported by 2 cuticular bars; 14 marginal hooklets. Intestinal branches not united posteriorly. Eyes present. Testis and ovary equatorial or postequatorial. Vitellaria usually extending into posterior third of body. Vagina present.

Type species.—*Ancyrocephalus paradoxus* Creplin, 1839.

The following species belong to the genus *Ancyrocephalus*: *A. atherinae* Price, 1934; *A. bassensis* Hughes, 1928; *A. lactophrys* (MacCallum, 1915); *A. manilensis* Tubangui, 1931; *A. paradoxus* Creplin, 1839; *A. similis*, n. sp.; *A. teuthis* (MacCallum, 1915); *A. tylosuri* (MacCallum, 1917); *A. vanbenedenii* (Parona and Perugia, 1890); and *A. vesiculosus* Murray, 1931. Of these species, *A. atherinae*, *A. lactophrys*, *A. similis*, *A. teuthis*, and *A. tylosuri* occur on North American fishes; descriptions of the forms from this continent except *A. atherinae* from *Atherina araea* Jordan and Gilbert, which was described by the present writer (1934), are given below.

Ancyrocephalus teuthis (MacCallum, 1915)

Johnston and Tiegs, 1922

Figs. 2-5

Synonym.—*Diplectanum teuthis* MacCallum, 1915.

Description.—Body slender, 1.1 to 1.2 mm long by 96 to 114 μ wide, sides parallel; anterior end slightly notched and somewhat narrower than remainder of body; cephalic glands present, in 4 groups, 1 group on each side of base of pharynx and 1 group on each side of median line anterior to oral aperture, opening to exterior through 3 pairs of head organs. Haptor 133 μ wide, not set off from body proper, with 2 pairs of large hooks supported by 2 cuticular bars and with 14 marginal hooklets; 2 small crescentic bodies also present in median line, lying side by side at level of roots of dorsal hooks. Large hooks unequal and dissimilar; those of dorsal pair sickle-shaped, 57 to 58 μ long, apparently with single, handle-like root and with angular blade; hooks of ventral pair simple 42, to 45 μ long, with slightly biramous roots; dorsal supporting bar somewhat yoke-shaped, about 45 μ long, ventral bar yoke-shaped, 43 to 49 μ long; marginal hooklets 15 μ long. Oral aperture ventral, at level of posterior pair of head organs; pharynx oval, 57 μ long by 45 μ wide; intestine not discernible. Eyes present, 2 pairs, anterior to pharynx. Genital aperture median, about 250 μ from anterior end of body. Cirrus tubular, curved, about 57 μ long, with delicate spiral ala. Testis oval, 133 μ long by 57 μ wide, equatorial. Ovary oval, median, pretesticular. Vitellaria extending from level of base of pharynx to about one-fourth of body length from posterior end. Vagina present, opening on right side of body about 325 to 245 μ from anterior end. Ootype elongate, its base surrounded by unicellular glands. No eggs observed.

Host.—*Acanthurus hepatus* (Linnaeus).

Location.—Gills.

Distribution.—United States (New York Aquarium).

Specimens.—U. S. N. M. Helm. Coll. Nos. 35689 (cotypes), 35690 and 35691.

Three slides containing several specimens and representing collections made by Dr. G. A. MacCallum on May 22, 1914; March 17, 1915; and November 24, 1915, respectively, were available for study. The specimens were fairly well preserved and stained, but some structures figured by MacCallum (1915), such as the esophageal glands, seminal vesicle and seminal receptacle, could not be made out.

The most distinguishing feature of the species is the structure of the dorsal hooks of the haptor; these have relatively long, apparently uniramous roots and peculiarly curved blades.

Ancyrocephalus lactophrys (MacCallum, 1915)

Johnston and Tiegs, 1922

Figs. 6-9

Synonym.—*Diplectanum lactophrys* MacCallum, 1915.

Description.—Body elongate, 650 to 950 μ long by 150 μ wide, slightly constricted at level of ootype. Cephalic glands in 2 groups, 1 on each side of pharynx, opening to exterior through 3 pairs of head organs; no esophageal glands observed. Haptor 170 to 190 μ wide, with 2 pairs of large hooks separated by cuticular bars, and with 14 marginal hooklets. Large hooks biramous 49 μ long; dorsal supporting bar 76 μ long, ventral bar 68 μ long; marginal hooklets 15 μ long. Oral aperture ventral, about 80 μ from anterior end of body; pharynx about 38 μ in diameter; intestinal tract not observable. Brain antero-dorsal to oral aperture; eyes present, 2 pairs. Genital aperture median, about 200 μ from anterior end of body. Cirrus tubular, about 105 μ long, no accessory piece observed; seminal vesicle somewhat S-shaped, to right of cirrus; vas deferens extending from testis to seminal vesicle, passing to left of cirrus and curving anterior to genital aperture. Testis oval, about 150 μ long by 95 μ wide, postequatorial. Ovary elongate oval, 100 μ by 57 μ wide, immediately pretesticular. Vitellaria extending from level of base of pharynx to near junction of haptor with body proper. Vagina present, relatively large, with distinct cuticular lining, the lining presenting a twisted appearance at proximal end of vagina. Ootype oval, its base surrounded by long-necked unicellular glands. Eggs not observed.

Host.—*Acanthostracion quadricornis* (Linnaeus).

Location.—Gills.

Distribution.—United States (New York Aquarium).

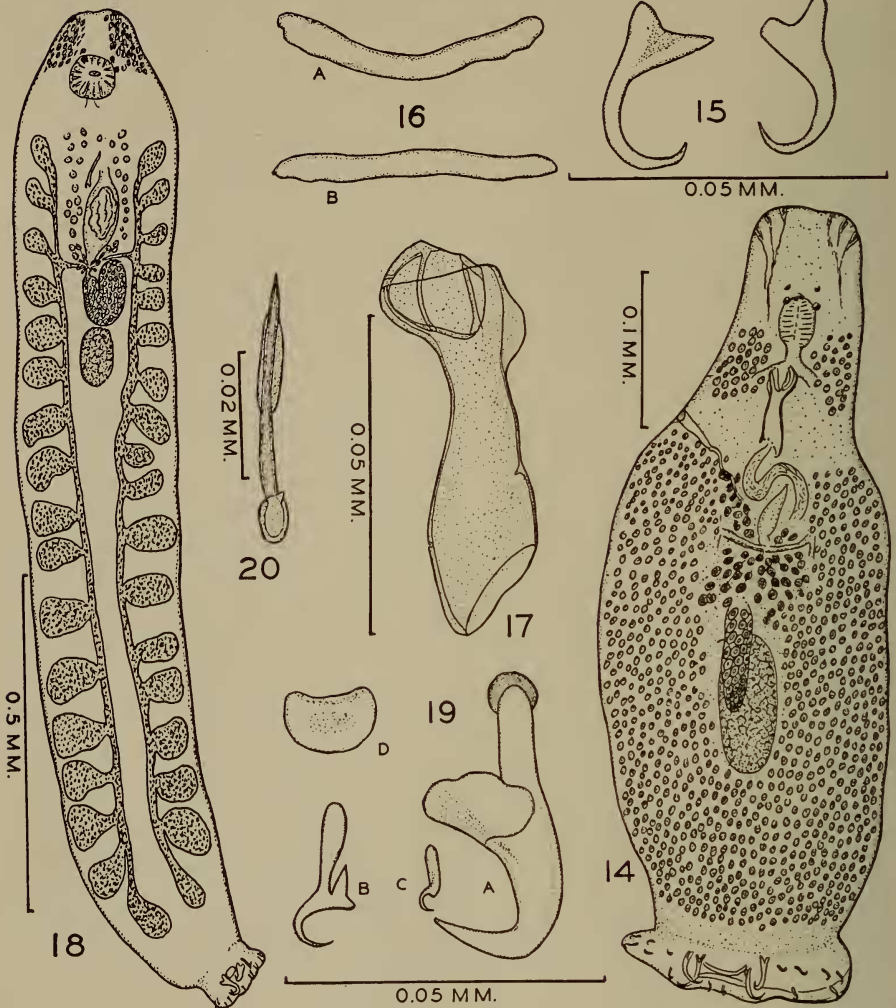
Specimens.—U. S. N. M. Helm. Coll. No. 35692 (cotypes).

Several specimens of this species were collected by Dr. G. A. MacCallum, February 19, 1915, from the gills of *Lactophrys tricornis* (= *Acanthostracion quadricornis*). The above description is based on these specimens.

Ancyrocephalus similis, n. sp.

Figs. 10-13

Description.—Body elongate, 850 to 936 μ long by 100 to 115 μ wide, lateral margins almost parallel for entire length. Cephalic glands on each side of pharynx, opening to exterior through 3 pairs of head organs. Haptor not set off from body proper, with 2 pairs of large hooks supported by 2 cuticular bars, and with (?) 14 marginal hooklets. Large hooks 57 to 60 μ



Figs. 14-17.—*Ancyrocephalus tylosuri*. 14, Complete worm, ventral view; 15, haptoral hooks; 16, haptoral bars (A—dorsal bar, B—ventral bar; drawn to same scale as Fig. 15); 17, cirrus. Figs. 18-20.—*Diplectanotrema balistes*. 18, Complete worm, ventral view; 19, haptoral hooks and bar (A—hook of ventral pair, B—hook of dorsal pair, C—marginal hooklet, D—bar); 20, cirrus.

long, roots biramous; dorsal supporting bar 42 to 57 μ long, ventral bar 57 to 65 μ long; marginal hooklets about 10 μ long. Oral aperture ventral, about 40 μ from anterior end of body; pharynx 40 μ long by 30 μ wide; intestinal tract not observed. Eyes present, 2 pairs, anterior to oral aperture. Genital aperture median, about 200 μ from anterior end of body. Cirrus 76 to 95 μ long, similar in shape to that of *A. lactophrys*. Testis oval, 75 μ long by 55 μ wide, postequatorial. Ovary elongate, median, pretesticular. Vitellaria as in *A. lactophrys*. Vagina short, without twisted cuticular lining as in *A. lactophrys*. No eggs observed.

Hosts.—*Priacanthus arenatus* Cuv. and Valenc. and *P. cruentatus* (Lacépède).

Location.—Gills.

Distribution.—United States (New York Aquarium).

Specimens.—U. S. N. M. Helm. Coll. Nos. 35693 (type and paratypes) and 35694.

This species is based on specimens collected by Dr. G. A. MacCallum. Two slides containing a number of specimens from each of the above-mentioned hosts were available; the specimens from *Priacanthus arenatus* had been collected June 20, 1915, and those from *P. cruentatus* on May 30, 1915.

Ancyrocephalus similis resembles *A. lactophrys* so closely that on casual examination the two forms appear to be identical. However, there are very significant differences in the morphology of the large hooks, supporting bars and cirri of the two species, which appear sufficient to warrant recognizing them as distinct.

Ancyrocephalus tylosuri (MacCallum, 1917)

Johnston and Tiegs, 1922

Figs. 14–17

Synonym.—*Diplectanum tylosuri* MacCallum, 1917.

Description.—Body somewhat elliptical, 510 to 645 μ long by 170 to 210 μ wide, anterior end more or less abruptly constricted. Cephalic glands numerous, on each side of pharynx, opening to exterior through 3 pairs of head organs. Haptor disc-like, about 150 μ wide, more or less sharply set off from body proper, with 2 pairs of large hooks supported by 2 cuticular bars, and with 14 marginal hooklets. Large hooks similar in shape, 23 μ long, with slightly biramous roots; ventral bar slightly sinuous, about 38 μ long; dorsal bar curved, about 38 μ long; marginal hooklets about 12 μ long. Oral aperture ventral, 50 to 55 μ from anterior end of body; pharynx oval, 27 μ long by 19 μ wide; intestinal tract not observed. Eyes present, 2 pairs, anterior to pharynx. Genital aperture median, about 100 μ from anterior end; cirrus 57 μ long, tubular, expanded distally, without accessory piece; seminal vesicle S-shaped. Testis oval, about 75 μ long by 40 μ wide, postequatorial. Ovary linguiform, 75 μ long by 20 μ wide, partly overlapping testis. Vitellaria occupying greater part of body from level of base of cirrus to posterior end of body proper. Vagina present, cuticular, somewhat trumpet-shaped, opening at body margin immediately in front of anterior limit of left vitellarium. Ootype elongate, its base surrounded by numerous, relatively large, unicellular glands. Eggs not observed.

Host.—*Strongylura marina* (Walbaum).

Location.—Gills.

Distribution.—United States (New York Aquarium).

Specimens.—U. S. N. M. Helm. Coll. No. 35695 (cotypes).

This species was described by MacCallum (1917) from specimens collected May 4, 1916 from a silver gar at the New York Aquarium; this re-description is based on the original specimens. All of the specimens had been stained and mounted and were not in good condition, consequently very little could be added to the original description. *A. tylosuri* may be easily distinguished from all other species of the genus by the position of the vaginal aperture and by the structure of the cirrus.

Ancyrocephalus spp.

Undetermined species of *Ancyrocephalus* have been reported from freshwater fishes in this country by Hess (1928, 1930) and by Van Cleave and Mueller (1934). In view of the fact that the genus *Ancyrocephalus*, *s. str.*, is composed of species from marine fishes, it appears safe to conclude that the forms reported by the above writers do not belong to that genus.

Genus HALIOTREMA Johnston and Tiegs, 1922

Diagnosis.—Body slightly constricted in equatorial region; 4 to 5 pairs of head organs. Haptor distinctly set off from body proper, with 2 pairs of large hooks supported by a pair of clamp-like bars, and with 14 marginal hooklets. Intestinal limbs not united posteriorly. Eyes absent. Testis and ovary in posterior third of mid-region of body. Cirrus large, complex. Vagina present, with heavily cuticularized lumen.

Type species.—*Haliotrema australe* Johnston and Tiegs, 1922.

This genus contains two species, *H. australe* Johnston and Tiegs from *Upeneus signatus* Gunther and *H. japonense* Yumaguti, from *Pseudupeneus chrysopleuron* (Tem. and Schl.), neither of which occurs in this country. So far as the writer has been able to ascertain this genus does not differ from *Ancyrocephalus* in any important character; the absence of eyes, if they are actually absent, seems to be the most important difference. Both Johnston and Tiegs (1922) and Yamaguti (1934) call attention to 2 pairs of gland cells in the vicinity of the oral cavity, but the arrangement of these cells suggests the possibility of unpigmented eyes having been mistaken for gland cells; however, until specimens of representatives of the genus are available for study this point cannot be settled and for the time being *Haliotrema* may be regarded as valid.

Genus DIPLECTANOTREMA Johnston and Tiegs, 1922

Diagnosis.—Body more or less uniform in width, 1 pair of head organs. Haptor cup-like, not distinctly set off from body proper, armed with 2 pairs of large hooks, the hooks of the 2 pairs markedly unequal and dissimilar, and with 14 marginal hooklets. Eyes present. Ovary and testis in anterior third of body; cirrus simple. Vitellaria consisting of very large discrete follicles arranged in linear series along sides of body, extending to near posterior end of body proper. Vagina apparently absent.

Type species.—*Diplectanotrema balistes* (MacCallum, 1915) new comb.

This genus was proposed as a subgenus of *Ancyrocephalus* by Johnston and Tiegs (1922) to contain *Diplectanum plurovitellum* MacCallum, 1916. This subgenus is regarded here as a distinct genus with *D. balistes* (MacCallum) as type, since, as will be shown later in this paper, MacCallum's *Diplectanum plurovitellum* and his *D. balistes* are identical, the latter having priority.

Diplectanotrema differs from *Ancyrocephalus* in having a single pair of head organs, in the marked dissimilarity of the large hooks of the haptor, and in the character of the vitellaria which are composed of large discrete

follicles arranged in linear series along each side of the body instead of small irregularly arranged follicles as in *Ancyrocephalus*.

***Diplectanotrema balistes* (MacCallum, 1915), n. comb. Figs. 18-20**

Synonyms.—*Diplectanum balistes* MacCallum, 1915; *Ancyrocephalus balistes* (MacCallum, 1915) Johnston and Tiegs, 1922; *Diplectanum plurovitellum* MacCallum, 1916; *Ancyrocephalus (Diplectanotrema) plurovitellum* (MacCallum, 1916) Johnston and Tiegs, 1922.

Description.—Body elongate, sides almost parallel, 850 μ to 1.4 mm long by 150 to 220 μ wide; cephalic glands present, prepharyngeal, opening to exterior through 1 pair of head organs. Haptor cup-like, 95 μ wide, not distinctly set off from body proper, with 2 pairs of large hooks supported by a single heavily cuticularized bar, and with 14 marginal hooklets; large hooks of ventral pair relative large, 42 μ long, with biramous roots; hooks of dorsal pair taenioid, 20 μ long; supporting bar more or less rectangular, 10 μ by 15 μ ; marginal hooklets about 10 μ long. Oral aperture ventral, median, about 100 μ from anterior end; pharynx globular, 57 to 75 μ in diameter; esophagus very short; intestine not traceable in available specimens. Brain antero-dorsal to pharynx; eyes present, 2 pairs. Genital aperture median, about 200 μ from anterior end of body. Cirrus slender, tubular, 40 μ long; accessory piece apparently simple. Testis oval, 95 μ long by 57 μ wide, about one-third of body length from anterior end. Ovary somewhat U-shaped, about 95 μ long by 68 μ wide. Vitellaria lateral, consisting of large discrete follicles arranged in linear series, each series connected by means of a longitudinal vitelline duct. Vagina apparently absent. Ootype relatively large, its posterior end surrounded by unicellular glands; large gland cells also present in median field on each side of ootype. Egg oval, 75 μ long by 45 μ wide.

Hosts.—*Balistes capriscus* Gmelin, *Acanthurus (Teuthis) hepatus* (Linnaeus) and *Anisotremus virginicus* (Linnaeus).

Location.—Gills.

Distribution.—United States (New York Aquarium).

Specimens.—U. S. N. M. Helm. Coll. Nos. 35696 (cotypes), 35697 (cotypes of *Diplectanum plurovitellum*) and 35698.

Diplectanotrema balistes was originally described as *Diplectanum balistes* by MacCallum (1915) from specimens collected January 13, 1913, from the gills of a trigger fish, *Balistes carolinensis* (= *B. capriscus*), at the New York Aquarium. The next year MacCallum (1916) described under the name of *Diplectanum plurovitellum* a species from the gills of *Teuthis hepatus* and *Anisotremus virginicus*; specimens from the former host were collected November 27, 1915, and those from the latter on March 5, 1916, as a slide bearing that date was found in his collection. The specimens from the two last mentioned hosts appear to be the same as those collected from *Balistes carolinensis*, since a careful comparison of these specimens revealed no essential differences. The specimens were not in good condition as they had apparently been fixed under pressure of a cover slip and somewhat distorted; due apparently to improper fixation, the specimens stained unevenly, and it seems that the difference in staining was responsible for the failure of MacCallum to recognize that he was dealing with a single species instead of two species. Some structures described and figured by MacCallum could

not be made out. The intestine which in his *D. balistes* is figured as consisting of 2 limbs, and which in his description of *D. pleurovitellum* is described as seeming "to join into a single tube posterior to the testis" could not be made out in any of the specimens; no vagina could be made out, although it is possible that a vagina may be present but so collapsed by pressure that it could not be located.

(to be continued)

MALACOLOGY.—*Two new land shells from Cuba.*¹ PAUL BARTSCH,
U. S. National Museum.

Cuba is the malacologists' paradise, for nowhere else do we find such a differentiation and concentration of land shells as is found on the "Pearl of the Antilles." On this account the Island has attracted to it naturalists of fame from the early days of malacology. The scholarly Poey, as well as men like Pfeiffer, Otto, Gundlach, Sagra, Wright and Arango, have all left their impress upon this science. However, it seems as if the mantle of all these explorers and naturalists, who have furthered our science, had fallen upon Cuba's genial scientist and scholar, Dr. Carlos de la Torre, whose researches in the malacological field have fine-tooth-combed the Island and brought to our ken treasures far excelling the greatest expectation that the earlier explorers might have visioned.

Working over a huge collection of Cuban shells has brought to light two of the most exquisite forms known to science, and I take great pleasure in dedicating both of them to my friend, Don Carlos.

Chondropometes (Chondropometes) torrei, n. sp. Fig. 2

Shell rather large, turbinate, thin, semi-translucent, openly umbilicated. Nuclear whorls translucent, pale yellow, the succeeding turns orange buff with varicial streaks of deeper orange. Peristome flame colored. Nuclear whorls about 2, in perfect conformity in their coiling with the postnuclear turns. The first thin, translucent, appearing granulose under high magnification; the last marked by feeble, somewhat retractively slanting, closely spaced, incremental lines. The postnuclear whorls inflated, well rounded, marked by very regular, retractively slanting sublamellar axial riblets which are a little less wide than the spaces that separate them. These riblets extend over the periphery into the umbilicus of the last turn, remaining of about the same strength throughout. In addition to these, there are narrow orange streaks at more or less regular intervals, which are occasioned by the approximation of two or more riblets. These are a little lighter than the rest of the shell. The spiral sculpture consists of almost obsolete threads which are narrower than the spaces that separate them and which render the riblets slightly wavy and under high magnification feebly serrulate. They are best developed on the anterior half of the whorls. The spiral threads are obsolete

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